




Phorate Technical Briefing



September 2, 1999



Introduction and Background Information



Phorate

- ★ Purpose of the Briefing
- ★ Public Participation
- ★ Regulatory History
- ★ Use Profile

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Introduction and Overview

Purpose of Briefing

- ❖ Present overview of phorate risk estimates
- ❖ Begin public participation period for risk mitigation strategies
- ❖ Identify where to focus mitigation

Introduction

Phorate Risk Assessments Consider:

- ❖ **Dietary risk:** *food and drinking water*
- ❖ **Aggregate risk:** *dietary (food) and drinking water*
- ❖ **Worker risk:** *loaders + applicators (handlers), flaggers, and postapplication workers*
- ❖ **Ecological risks:** *birds, mammals, honey bees, fish, and other aquatic species*

Phorate Risk Assessments DO NOT Consider:

- ❖ **Residential risk:** *no residential uses*

Introduction

TRAC Pilot Public Participation Process for Phorate

Phase	Health Effects Assessment	Ecological Assessment
❶ "Error Only" Review	9/8/98	8/98
❷ Error Correction	9/8/98	9/98
❸ Public Comment Period	10/98	10/98
❹ Revised Assessment to USDA	3/99	3/99
❺ Develop Risk Mgt. Options	9/2/99	9/2/99
❻ Develop Transition Strategy		

Introduction

Phase 1: "Error Only" Review by Registrant

Phase 2: Error Correction

- ❖ Concerns for acute dietary risk, worker risk, and ecological risk

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Phase 3: Public Participation

- ❖ Importance and benefits to agriculture
- ❖ Agency policies (common mechanism of toxicity, FQPA safety factor, assumptions and methodologies)
- ❖ Outstanding data and submission schedule

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Phase 4: Solicit Comments from USDA

- ❖ Revisions made to assessment possible future changes include:
 - ◆ Use of PDP/FDA information and 95/99% for dietary risk assessment
 - ◆ Clarification of Pesticide Handlers Exposure Database (PHED) calculations
 - ◆ Label questions
 - ◆ Drinking water exposure

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Phase 4: Data Received After Public Comment Period

- ❖ Monte Carlo analysis
- ❖ Acute neurotoxicity study
- ❖ 28-day dermal study
- ❖ Surrogate terbufos dermal worker exposure study
- ❖ Hydrolysis/pond water on metabolites (sulfone and sulfoxide)
- ❖ Subchronic neurotoxicity study (received August 1999)

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Introduction

Phase 5: Start of Risk Management

- ❖ Technical briefing (September 2, 1999)
- ❖ Revised risk assessment (incorporating all studies EXCEPT subchronic neurotoxicity) available in public docket and on the internet
- ❖ Begin 60-day public participation period
- ❖ Public submits risk management ideas
- ❖ Opportunities for stakeholders to meet with EPA

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Regulatory History

- ❖ First registered 1959
- ❖ Classified as a Restricted-Use Pesticide (RUP) in 1979
- ❖ Registration standard 1984
- ❖ Registration standard amended 1988
- ❖ Grassley-Allen letter 1988 and 1990

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Use and Usage Profile

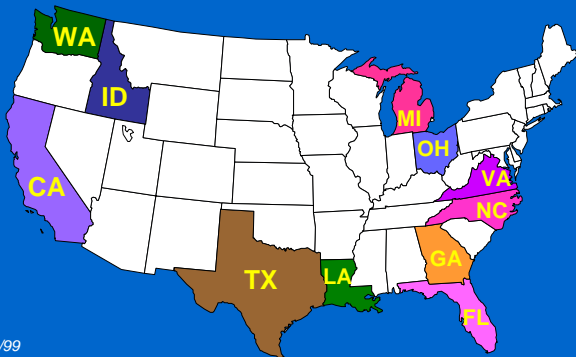
- ❖ Phorate is a systemic soil insecticide/nematicide
 - ♦ 11 registered food uses
 - ♦ commercial bulb production
- ❖ Each year, almost 3 million pounds ai used on 2.5 million acres:

Crop	% Used	%CT
Field Corn	45	<2
Potatoes	24	20
Cotton	15	5
Peanuts	5	10
Sugar Cane	5	6
Sweet Corn	2	4
Sugar Beets	1	<1
Sorghum	<1	<1
Winter Wheat	<1	
Beans	<1	
Soybeans	<1	

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Use Profile

- ❖ Mainly used in: *FL, CA, GA, TX, ID, OH, WA, LA, VA, NC, and MI*



Use Profile

Use Practices

- ❖ Application methods
 - ♦ Ground
 - ♦ Aerial
 - *small percentage of usage: field corn, wheat, sorghum, sugar beets*
- ❖ Use rates
 - ♦ <1 to 3.3 lb ai/A
 - <1 lb ai/A for most crops
 - higher for a few crops

Use Profile

Use Practices (con't)

- ❖ Reentry intervals and pre-harvest intervals
 - ◆ REI: 48-72 hours
 - ◆ Days to harvest
 - sorghum - 30 days
 - wheat - 70 days
 - cotton - 60 days
 - potatoes - 90 days

Use Profile

- ❖ Sources of use and usage data
 - ◆ Product labels
 - ◆ EPA (1988-97)
 - ◆ USDA/NASS (1990-96)
 - ◆ National Center for Food and Agricultural Policy (1994)

Human Health Risk Assessment



Risk Assessment Components

- ❖ Dietary:
 - ◆ Food
 - ◆ Drinking water
- ❖ Occupational
 - ◆ Application
 - ◆ Postapplication

NOTE: *There are no residential uses of phorate*

Dietary Risk Equation

Risk = hazard x exposure, where

$$\text{Exposure} = \text{consumption} \times \text{residue}$$

Effect Levels

- ❖ Lowest Observed Adverse Effect Level (LOAEL)
 - ♦ The lowest dose at which an “adverse” health effect is seen
 - ♦ Units of mg per kg body weight per day (mg/kg bw/day)
- ❖ No Observed Adverse Effect Level (NOAEL)
 - ♦ The highest dose at which **no** “adverse” health effect is seen
 - ♦ The NOAEL dose is less than the LOAEL
 - ♦ Units of mg per kg body weight per day (mg/kg bw/day)

Analysis of Special Sensitivity for Infants and Children

FQPA Safety Factor Reduced to 3X:

- ❖ Incomplete neurotoxicity database
- ❖ No developmental effects in fetuses below maternally toxic doses
- ❖ No increased sensitivity in pups relative to adults
- ❖ No abnormalities in developing fetal nervous system
- ❖ Unlikely that exposures are underestimated

Regarding the developmental neurotoxicity study:
the Agency has recently announced that it will issue
a DCI

Acute Hazard (Toxicity)

Study:	Rat acute neurotoxicity
Endpoint: (toxic effect)	Miosis (pupil constriction – an early sign of neurotoxicity); brain cholinesterase inhibition in males
NOAEL:	0.25 mg/kg/day
LOAEL:	0.5 mg/kg/day

NOTE: Endpoints from this study most accurately reflect toxicity that could result from one day of dietary exposure to phorate.

Acute Population Adjusted Dose (aPAD)

aPAD = 0.00083 mg/kg/day, based on:

- ❖ NOAEL of 0.25 mg/kg/day
- ❖ Uncertainty factors:
 - ◆ 10X interspecies extrapolation
 - ◆ 10X intraspecies variability
 - ◆ 3X FQPA safety factor

Chronic Hazard (Toxicity)

Study:	Dog Chronic Toxicity
Endpoint:	RBC and Brain Cholinesterase Inhibition
NOAEL:	0.05 mg/kg/day
LOAEL:	0.25 mg/kg/day

NOTE: *Endpoints from this study most accurately reflect toxicity that could result from long-term dietary exposure to phorate*

Chronic Population Adjusted Dose (cPAD)

cPAD = 0.00017 mg/kg/day, based on:

- ❖ NOAEL of 0.05 mg/kg/day
- ❖ Uncertainty factors:
 - ◆ 10X interspecies extrapolation
 - ◆ 10X intraspecies variability
 - ◆ 3X FQPA safety factor

Exposure: *Consumption*

- ❖ USDA's Continuing Survey of Food Intake by Individuals (CSFII) 1989-92 data
 - ◆ 1994-96 data are being validated for use in the near future
 - ◆ Supplemental children's consumption data due in December 1999

Phorate Residues of Concern

- ❖ Phorate
- ❖ Phorate sulfoxide
- ❖ Phorate sulfone
- ❖ Phorate oxygen analog
- ❖ Phorate oxygen analog sulfoxide
- ❖ Phorate oxygen analog sulfone

Characterization of Residue Data

- ❖ Most field trial data show non-detectable residues
- ❖ Minimal field trial data for some commodities at current label conditions
- ❖ FDA and PDP have not found residues exceeding LOQ since 1993 in/on any commodity with the exception of potatoes
- ❖ Rate of detections for potatoes is 2%
 - ◆ Several samples in the past few year bore residues close to the recommended reassessed tolerance of 0.2 ppm

Residue Data Used for Acute and Chronic Risk Estimation

- ❖ Only field trial data were used
- ❖ Used 1/2 limit of detection
- ❖ FDA and PDP did not monitor all metabolites of concern
- ❖ Limits of detection were lower in the field trial data

Residue Data Used for Acute and Chronic Risk Estimation

- ❖ Used processing and cooking factors for potatoes
- ❖ Studies indicated that residues of concern are destroyed during carbonation/lime processes for sugar processing, so assumed residues of 0 for sugar

Acute Risk Estimates

Population	% aPAD at the 99.9 th Percentile
General U.S	40
Infants	40
Children 1-6	70
Children 7-12	50

Sensitivity Analysis

Assume Zero Residues for All Commodities Except Peanuts, Potatoes, and Sweet Corn

Population	% aPAD all Commodities	%aPAD Using Zero Residue Assumption
U.S. Population	40	40
Infants	40	40
Children 1-6	70	70
Children 7-12	50	50

Chronic Risk Estimates

Population	% c PAD
General U.S	3
Infants	1
Children 1-6	9
Children 7-12	6

Environmental Fate of Phorate

- ❖ Major route of degradation
 - ♦ Microbial and chemical degradation
- ❖ Persistence and mobility
 - ♦ Phorate parent degrades rapidly and is moderately mobile in soil
 - ♦ Phorate sulfoxide and sulfone are more persistent and mobile than parent phorate
- ❖ Phorate sulfoxide and sulfone are more likely to reach water resources than parent phorate

Drinking Water Assessment

Surface Water

- ❖ Monitoring data for corn use show limited detections of parent phorate
- ❖ PRZM-EXAMS model used to estimate concentrations of parent phorate and sulfoxide/sulfone metabolites

Drinking Water Assessment

Surface Water (con't)

- ❖ Peak (acute) estimated environmental concentrations (EEC's) were similar for parent phorate and the total toxic residue (parent + metabolites)
 - ♦ 1.3 to 1.7X
- ❖ Longer term (chronic) eecs were higher for the total toxic residue than for phorate parent alone
 - ♦ 6 to 12X

Drinking Water Assessment

Groundwater

- ❖ Monitoring data show no detections of parent phorate
- ❖ Very few samples were analyzed for metabolites
- ❖ SCI-GROW model used to estimate concentrations of parent and metabolites

Drinking Water Assessment: Results Summary

“✓” means that the risk estimate is below the Agency’s level of concern*

(note: this analysis is based on modeling data)

Duration of Exposure	Surface Water		Groundwater	
	Adults	Children 1-6	Adults	Children 1-6
Acute			✓	
Chronic	✓	✓		

*that is, the DWLOC, which is the Agency’s ‘level of comparison,’ is larger than the modeled screening estimate, which is calculated for aggregate drinking water and food exposure

Aggregate Risk Assessment

- ❖ Includes exposures from various sources:
 - ♦ Food, drinking water, residential, and other non-occupational
- ❖ No registered residential uses:
 - ♦ For example, phorate is not registered for use in homes, on lawns, golf courses, etc
- ❖ Aggregate risk assessment for phorate includes food and drinking water only

Aggregate Risk Assessment Results

- ❖ Acute and chronic aggregate -- food & water only
 - ♦ Food exposure not of concern
 - ♦ Drinking water exposure (based on model) may be of concern
- ❖ Monitoring data for parent and degradates may allow EPA to refine risks

Phorate Occupational Risk Assessment

Handlers

- ♦ *includes professional pesticide applicators, farmer/growers who load and apply pesticides, and flaggers.*

Postapplication Workers

- ♦ *significant exposure not expected.*

Phorate Worker Assessment

❖ Handler Exposure and Risk Calculations

$$\text{Dose} = \frac{(\text{Unit Exposure}) \times (\text{Amount Handled})}{\text{Body Weight}}$$

$$\text{Margin Of Exposure (MOE)} = \frac{\text{NOAEL (mg/kg/day)}}{\text{Dose (mg/kg/day)}}$$

❖ Post-Application Exposure and Risk:

- ♦ significant exposure not expected.

Application Exposure Information

- ❖ Formulations are clay-based granulars
 - ♦ “Lock-n-load” (i.e., “closed system”)
 - ♦ Open bag packaging (i.e., “open system”)
- ❖ Applied by ground and aerial equipment
 - ♦ Most by ground at-plant with soil incorporation
 - ♦ Maximum application rate from 1.3 to 4.0 lb ai/A

Phorate Toxicity Endpoints for Occupational Risk Assessment

Study	Duration of Exposure (days)	Effects	NOAEL (mg/kg/day)
Dermal			
28-day dermal	≤28	RBC, brain, and plasma	0.4
Chronic dog	>28	RBC, brain, and plasma	0.05 (with 100% dermal absorption)
Inhalation			
Rat acute neurotoxicity	≤7	Miosis and brain	0.25
Chronic dog	>7	RBC, brain, and plasma	0.05

Exposure Data and Approaches

- ❖ Terbufos 15G “Lock-N-Load”/closed cab study
- ❖ PHED data (e.g., open bag/open cab) used for handler scenarios
- ❖ Combined dermal and inhalation routes

Handler Assessment Scenarios

- ❖ Loaders
 - ◆ Open systems (i.e., open bags)
 - ◆ Closed “lock-n-load” systems
- ❖ Applicators
 - ◆ Open and closed cabs for ground equipment
 - ◆ Closed cab aerial
- ❖ Flaggers

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Phorate Handler Assessment Results:
For Exposure Durations of <28 Days

- ❖ For open systems, risk concern exists for most scenarios

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Phorate Handler Assessment Results:
For Exposure Durations of < 28 Days

Job	Margins-of-Exposure (MOE's)	
	From PHED (open bag)	From Lock-N-Load Study (closed cab)
Loaders	all >100*	all >100
Applicators	all <100 (aerial and ground)	all >100 (ground application only)
Flaggers	all >100*	N/A

*Requires engineering controls

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Handler Assessment Results: *For Exposure Durations > 28 Days*

Job	Margins-of-Exposure (MOE's)	
	From PHED (open bag)	From Lock-N-Load Study (closed cab)
Loaders	Most <100*	all >100*
Applicators	all <100 (aerial and ground)	all >100* (ground application only)
Flaggers	all >100*	N/A

*Requires engineering controls

...

Phorate Handler Risk Summary

- ❖ Exposure data from study are acceptable
- ❖ MOE's for ground applications:
 - ♦ >100 for loaders and applicators using ground equipment (*with Lock-N-Load, closed cab, and PPE*)
 - ♦ <100 for open systems
- ❖ MOE's for flaggers:
 - ♦ >100 (*with engineering controls*)
- ❖ MOE's for aerial applicators:
 - ♦ <100

Summary of Incident Data

- ❖ Poison control center data (1985-92) showed higher risk than most other OP's of serious outcomes
- ❖ More recent Poison Control Center data (1993-96) showed a significant decrease in the number of incidences
- ❖ California data suggest high risk compared to other pesticides (poisonings per 1000 applications) to both applicators and field workers (though based on small number of cases)

Ecological Assessment



Ecological Risk Assessment

- ❖ Environmental fate and transport
 - ♦ Laboratory and field studies
- ❖ Water resource
 - ♦ Modeling and monitoring
- ❖ Ecotoxicity
 - ♦ Acute and chronic studies
- ❖ Ecological risk
 - ♦ Exposure and toxicity
 - ♦ Incidents

Summary of Ecological Toxicity

Species	Toxicity
Birds	Very high
Mammals	Very high
Honey Bees	Moderate to high
Fish	Very high
Aquatic Invertebrates	Very high

Ecological Risk Assessment: Toxicity and Exposure

- ❖ **Risk quotients (RQ):** *ratio of estimated exposure concentration to toxicity endpoint*

Acute RQ = $\frac{\text{peak environmental concentration}}{\text{LD50, LC50, or EC50}}$

Chronic RQ = $\frac{\text{long-term average concentration}}{\text{NOAEC}}$

- ❖ RQ is compared to levels of concern (LOC)

Summary of Aquatic Ecological Concerns

- ❖ Results for all scenarios except the potato scenario*

Duration	Level of Concern	RQ's
Fish (freshwater and marine/estuarine)		
Acute	RQ ≥ 0.5	7.7 to 383
Chronic	RQ ≥ 1	1 to 646
Invertebrates (freshwater and marine/estuarine)		
Acute	RQ ≥ 0.5	13 to 1255
Chronic	RQ ≥ 1	16 to 11700

*The potato scenario is left out because the exposure is negligible

NOTE: Analysis based on exposure to parent phorate + phorate metabolites, simulated using PRZM and EXAMS

Summary of Terrestrial Ecological Concerns

Risk to Birds and Mammals

Species		Level of Concern	RQ's
Acute	Avian	RQs ≥ 0.5	0.5 to 625
	Mammal		0.5 to 1489

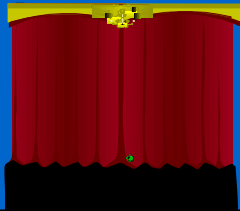
Summary of Ecological Incidents for Phorate

- ❖ Terrestrial and aquatic concerns are further supported by incidents
- ❖ An important pattern involving applications to winter wheat:
 - ◆ mortality of waterfowl in pools that form in fields
 - ◆ secondary poisoning of raptors
 - ◆ sometimes mortality of large numbers of birds
 - ◆ sometimes mortality months following application



Summary and Conclusion

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Summary

Phase 5: Start of Risk Management

- ❖ Technical briefing (September 2, 1999)
- ❖ Revised risk assessment (incorporating all studies) available in public docket and on the internet
- ❖ Begin 60-day public participation period
- ❖ Public submits risk management ideas
- ❖ Opportunities for stakeholders to meet with EPA

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Summary of Dietary Risk Assessment

❖ Acute dietary risk*:

- ◆ **Below** level of concern for all subpopulations, at 99.9th percentile

❖ Chronic dietary risk*:

- ◆ **Below** level of concern for all subpopulations, at 99.9th percentile

*Review of subchronic neurotoxicity study (Aug '99) may further reduce risk

❖ Drinking water exposure:

- ◆ **May pose problems** based on modeling data

Summary of Handler Risk Assessment

Handler exposure (mixer/loader/applicator)

❖ Risks to mixers/loaders/applicators are not of concern with:

- ◆ **PPE Maximum**
- ◆ **Lock-N-Load (closed system)**

Summary of Ecological Risks

- ❖ Risks to birds, fish, and mammals are high
- ❖ Serious concerns regarding the high number of ecological incidents

In Conclusion....

We Invite Comments and Dialogue Regarding:

- ♦ Estimating exposure to phorate and its' metabolites via drinking water
- ❖ Feasibility of shifting to "Lock-N-Load" systems
- ❖ Reducing ecological incidents